

# PSR J0007+7303 in the CTA1 SNR: New Gamma-ray Results from Two Years of *Fermi*-LAT Observations

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## ABSTRACT

One of the main results of the *Fermi* Gamma-Ray Space Telescope is the discovery of  $\gamma$ -ray selected pulsars. The high magnetic field pulsar, PSR J0007+7303 in CTA1, was the first ever to be discovered through its  $\gamma$ -ray pulsations. Based on analysis of 2 years of LAT survey data, we report on the discovery of  $\gamma$ -ray emission in the off-pulse phase interval at the  $\sim 6\sigma$  level. The flux from this emission in the energy range  $E \geq 100$  MeV is  $F_{100} = (1.73 \pm 0.40) \times 10^{-8}$  photons  $\text{cm}^{-2} \text{s}^{-1}$  and is best fitted by a power law with a photon index of  $\Gamma = 2.54 \pm 0.14$ . The pulsed  $\gamma$ -ray flux in the same energy range is  $F_{100} = (3.95 \pm 0.07) \times 10^{-7}$  photons  $\text{cm}^{-2} \text{s}^{-1}$  and is best fitted by an exponentially-cutoff power-law spectrum with a photon index of  $\Gamma = 1.41 \pm 0.23$  and a cutoff energy  $E_c = 4.04 \pm 0.20$  GeV. We find no flux variability neither at the 2009 May glitch nor in the long term behavior. We model the  $\gamma$ -ray light curve with two high-altitude emission models, the outer gap and slot gap, and find that the model that best fits the data depends strongly on the assumed origin of the off-pulse emission. Both models favor a large angle between the magnetic axis and observer line of sight, consistent with the nondetection of radio emission being a geometrical effect. Finally we discuss how the LAT results bear on the understanding of the cooling of this neutron star.

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